SCHEME : K

Name : _____

Roll No. : _____ Year : 20___ 20___

Exam Seat No. : _____

LABORATORY MANUAL FOR

ELEMENTS OF ELECTRICAL ENGINEERING

(312315)

ELECTRONICS ENGINEERING GROUP

MAHARASHTRA STATE BOARD OF
TECHNICAL EDUCATION, MUMBAI
(Autonomous) (ISO 9001: 2015) (ISO/IEC 27001:2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of Technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the challenging technological & environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the following:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual For

ELEMENTS OF ELECTRICAL ENGINEERING

(312315)

Semester – II

(AO/ DE/ EJ/ ET/ EX/ IC/ IE/ IS/ MU/ TE)

Maharashtra State

Board of Technical Education, Mumbai

(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education, Mumbai

(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)

4th Floor, Government Polytechnic Building, 49, Kherwadi, Bandra (East), Mumbai- 400051.

MAHARASHTRA STATE

BOARD OF TECHNICAL EDUCATION

Certificate

This is to certify that Mr. /Ms.……

Roll No. ……of Second Semester of Diploma in …..……..……of Institute ……..…… (Code : ……) has completed the term work satisfactorily in course **Elements of Electrical Engineering (312315)** for the academic year 20…….to 20…….. as prescribed in the curriculum.

Place: …….. **Enrollment No: …….**

Date: ……. **Exam Seat No: ……**

Subject Teacher Head of department Principal

Seal of Institute

Preface

The primary focus of any engineering laboratory/field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'K' Scheme curricula for engineering diploma programmes with outcome-based education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher, instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a 'vehicle' to develop this industry identified competency in every student. The practical skills are difficult to develop through "chalk and duster" activity in the classroom situation. Accordingly, the „K‟ scheme laboratory manual development team designed the practicals to focus on the outcomes, rather than the traditional age old practice of conducting practicals to 'verify the theory" (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

This course deals with the basic fundamentals of electrical engineering and working principles of commonly used AC and DC motors and their characteristics. The basic concepts of electrical engineering in this course will be very useful for understanding electrical circuits.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome.

Program Outcomes (POs)

- **PO 1. Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, sciences and engineering fundamentals and engineering specialization to solve the engineering problems.
- **PO 2. Problem analysis:** Identify and analyze well-defined engineering problems using codified standard methods.
- **PO 3. Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of system components or processes to meet specified needs.
- **PO 4. Engineering tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
- **PO 5. Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
- **PO 6. Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
- **PO 7. Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.

Program Specific Outcomes (PSOs)

- **PSO 1. Electronics and Telecommunication Systems:** Maintain various types of Electronics and Telecommunication systems.
- **PSO 2. EDA Tools Usage:** Use EDA tools to develop simple Electronics and Telecommunication engineering related circuits.

Program Educational Objectives (PEOs)

- **PEO 1.** Provide socially responsible, environment friendly solutions to Electronics and Telecommunication engineering related broad-based problems adapting professional ethics.
- **PEO 2.** Adapt state-of-the-art Electronics and Telecommunication engineering broad-based technologies to work in multi-disciplinary work environments.
- **PEO 3.** Solve broad-based problems individually and as a team member communicating effectively in the world of work.

List of Industry Relevant Skills

The following industry relevant skills of the competency "Use electrical equipment in industrial applications." are expected to be developed in you by undertaking the practicals of this laboratory manual.

1. Interpret the magnetic field parameters for the particular magnetic circuits.
2. Analyze A.C. circuits for single phase and polyphase supply.
3. Select the transformer and DC motor for the given application.
4. Select the fractional horse power motor for the given application.
5. Choose the protective devices for the electrical protection.

Brief Guidelines to Teachers.

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain prior concepts to the students before starting of each experiment
3. Involve students in performance of each experiment.
4. Teacher should ensure that the respective skills and competencies are developed in. the students after the completion of the practical exercise.
5. Teachers should give opportunity to students for hands on experience after the demonstration.
6. Teacher is expected to share the skills and competencies to be developed in the students.
7. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.
8. Finally give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.

Instructions for Students

1. Listen carefully the lecture given by teacher about subject, curriculum, learning structure, skills to be developed.
2. Organize the work in the group and make record all programs.
3. Students shall develop maintenance skill as expected by industries.
4. Student shall attempt to develop related hand-on skills and gain confidence.
5. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual.
6. Student shall refer technical magazines.
7. Student should develop habit to submit the practicals on date and time.
8. Student should well prepare while submitting write-up of exercise.
9. Attach/paste separate papers wherever necessary.

Practical Course Outcome matrix

COURSE LEVEL LEARNING OUTCOMES (COS)

CO1 - Interpret the magnetic field parameters for the particular magnetic circuits.

CO2 - Analyze A.C. circuits for single phase and polyphase supply.

CO3 - Select the transformer and DC motor for the given application.

CO4 - Select the fractional horse power motor for the given application.

CO5 - Choose the protective devices for the electrical protection.

Sr. No.	Title of the Practical	CO1	CO2	CO3	CO4	CO5
1.	Demonstration of Faraday's law of electro-magnetic induction for statically and dynamically induced emf.	✓	-	-	-	-
2.	Demonstration of Mutually induced EMF by using single-phase transformers.	✓	-	-	-	-
3.	Measure frequency, Time period, Peak value, RMS value of sinusoidal AC waveform using CRO.	-	✓	-	-	-
4.	Observe the phase difference between voltage and current on CRO for resistive, inductive, and capacitive load and comment on the nature of the power factor (Lagging, Leading, and Unity).	-	✓	-	-	-
5.	Connect three phase star connected balanced load and verify the relationship between line voltage and phase voltage, line current and phase current.	-	✓	-	-	-
6.	Connect three phase delta connected balanced load and verify the relationship between line voltage and phase voltage, line current and phase current.	-	✓	-	-	-
7.	Determine the transformation ratio current ratio of single phase transformer.	-	-	✓	-	-
8.	Demonstration of working of pulse transformer by observing input pulse and output pulse of pulse transformer on CRO.	-	-	✓	-	-
9.	Identify different types of DC motor by observing terminal connections and also identify different parts of DC motor.	-	-	✓	-	-
10.	Start any DC motor using corresponding starter and observe speed on tachometer.	-	-	✓	-	-
11.	Start single phase induction motor and reverse the direction of rotation of it.	-	-	-	✓	-
12.	Start universal motor and reverse the direction of rotation of it.	-	-	-	✓	-

13.	Identify different parts of linear induction motor and start it.	-	-	-	✓	-
14.	Identify different types of fuses and circuit breakers. State their specification for suitable application.	-	-	-	-	✓
15.	Testing of earthing using a test lamp and comment on it.	-	-	-	-	✓

Content Page

List of Practical's and Progressive Assessment Sheet

9.	Identify different types of DC motor by observing terminal connections and also identify different parts of DC motor.	47					
10.	Start any DC motor using corresponding starter and observe speed on tachometer.	52					
11.	Start single phase induction motor and reverse the direction of rotation of it.	57					
12.	Start universal motor and reverse the direction of rotation of it.	63					
13.	Identify different parts of linear induction motor and start it.	67					
14.	Identify different types of fuses and circuit breakers. State their specification for suitable application.	73					
15.	Testing of earthing using a test lamp and comment on it.	78					

Practical No. 1: Demonstration of Faraday's law of electro-magnetic induction for statically and dynamically induced emf

I Practical Significance:

In industries measurements of static and dynamic emf with utmost accuracy and precision is a prime requirement. Such kind of measurements are possible using measuring instruments like voltmeter, ammeter etc. In this practical we use voltmeter, ammeter to measure the static induced emf.

II Industry/Employer Expected Outcome(s)

Use electrical equipment efficiently for different electronic engineering application.

III Course Level Learning Outcome(s)

Interpret the magnetic field parameters for the particular magnetic circuits.

IV Laboratory Learning Outcome(s)

LLO 1 Use Faraday's law of electro-magnetic induction.

LLO 2 Classify types of induced emf.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background (With diagrams if required)

Faraday's first law: when the flux linking the conductor or coil changes an emf is induced in it.

Faraday's second law: the magnitude of induced emf in a coil is directly proportional to the rate of change of flux linkages.

Flux linkages: the product of number of turns (N) of the coil and magnetic flux (Φ) linking the coil is called flux linkages

Flux linkages = N* Φ

Induced emf a $\mathbf{N}\frac{d\emptyset}{dt}$

Where

N= no. of turns on coil

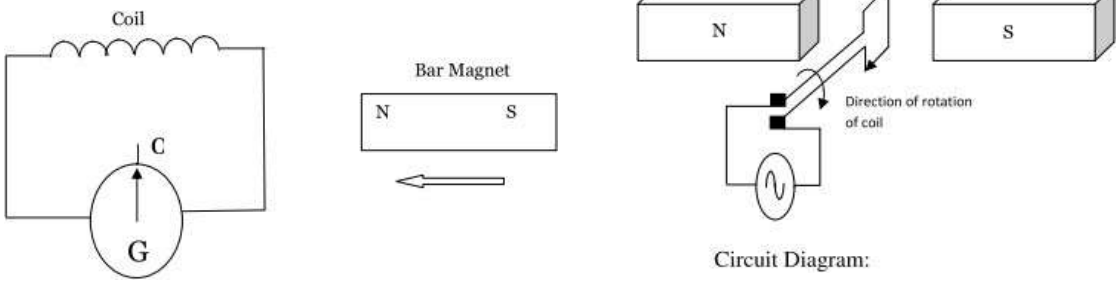
$\frac{d\emptyset}{dt}$ = rate of change of flux linkages

Statically induced emf: the emf generated due to the conductors or coil remain stationary and the flux linking these conductor is changed is called statically induced emf

Statically induced emf divided as self-induced emf and mutually induced emf.

Dynamically induced emf: The emf generated due to motion of the conductor in stationary magnetic field or by the motion of the magnetic field and the conductor is stationary is called as dynamically induced emf.

VII Actual Circuit diagram used in laboratory with equipment Specifications:



Circuit Diagram:

VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Bar magnet	Bar magnet of known polarity	1 No.
2	Galvanometer	Suitable range	1 No.
3	Inductive coil	Any suitable coil having large number of turns	1 No.

IX Precautions to be followed:

1. Avoid loose connections.
2. Don't touch wire with wet hands.

X Procedure

1. Connect two ends of the coil to the Galvanometer.
2. Take a bar magnet of known polarity.
3. Move the bar magnet in the coil as per the sequence given in observation table.
4. Observe the deflection of Galvanometer.

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			
3			

XII Actual Procedure Followed:

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XIII Observation table for statically induced emf

S.N.	Movement of Bar Magnet	Movement of the Magnet	Deflection of Galvanometer connected across coil	
			Forward / Reverse	Less/ More
1	Towards the coil	Slow		
2	Towards the coil	Fast		
3	Away from the coil	Slow		
4	Away from the coil	Fast		

Observation table for dynamically induced emf

S.N.	Position of the Magnet	Movement of the Magnet	Deflection of Galvanometer	
			Forward / Reverse	Less/ More
1	N- Pole towards the coil	Slow		
2	N- Pole towards the coil	Fast		
3	S- Pole towards the coil	Slow		
4	S- Pole towards the coil	Fast		

XIV Result(s)

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XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. Define magnetic flux.
2. Define flux linkages.
3. State Faraday's laws of electromagnetic induction.
4. State Lenz's law.
5. State Fleming's Right Hand Rule

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XVIII References/Suggestions for further reading:

1. www.electrical4u.com
2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 2: Demonstration of Mutually induced EMF by using single-phase transformers.

I Practical Significance:

In industries measurements of mutually induced emf with utmost accuracy and precision is a prime requirement. Such kind of measurements are possible using measuring instruments like voltmeter, ammeter etc. In this practical we use voltmeter, ammeter to measure the mutually induced emf.

II Industry/Employer Expected Outcome(s)

Use electrical equipment efficiently for different electronic engineering application.

III Course Level Learning Outcome(s)

Interpret the magnetic field parameters for the particular magnetic circuits.

IV Laboratory Learning Outcome(s)

LLO Use Faraday's law of electro-magnetic induction.

LLO Observe mutual induced emf in transformer

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background (With diagrams if required)

Faraday's first law: when the flux linking the conductor or coil changes an emf is induced in it.

Faraday's second law: the magnitude of induced emf in a coil is directly proportional to the rate of change of flux linkages.

Flux linkages: the product of number of turns (N) of the coil and magnetic flux (Φ) linking the coil is called flux linkages

Flux linkages = N* Φ

Induced emf a $\mathbf{N}\frac{d\emptyset}{dt}$

Where

N= no. of turns on coil

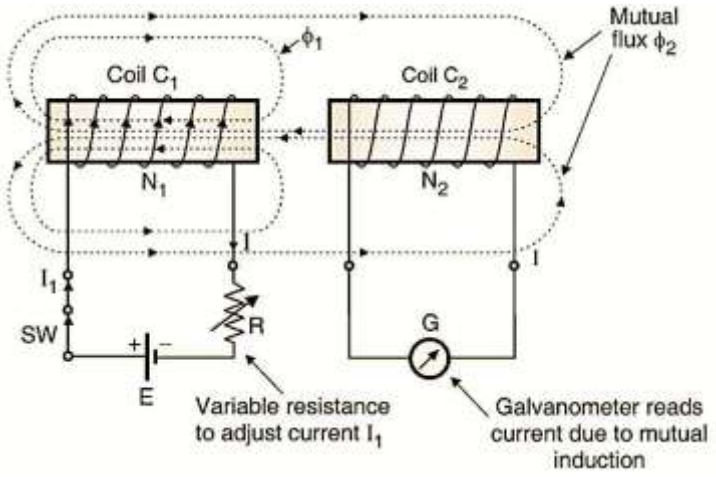
$\frac{d\emptyset}{dt}$ = rate of change of flux linkages

Statically induced emf: the emf generated due to the conductors or coil remain stationary and the flux linking these conductor is changed is called statically induced emf

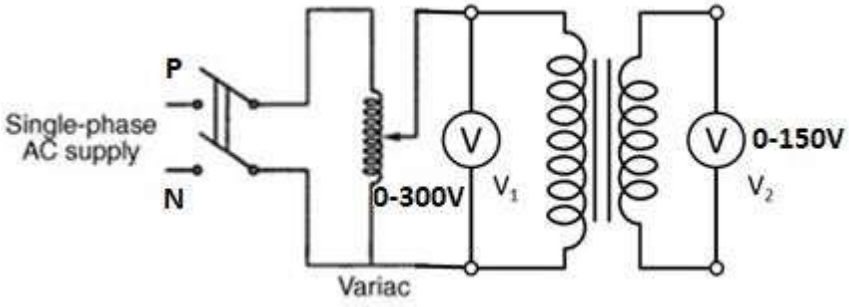
Statically induced emf divided as self-induced emf and mutually induced emf.

Self induced emf: The emf induced in a coil due to the change of its own flux linked with it is called as self induced emf.

Mutually induced emf: the emf induced in a coil due to the changing current in the neighboring coil is called mutually induced emf.



VII Actual Circuit diagram used in laboratory with equipment Specifications:



VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Voltmeter	0-300 V AC	1
2	Voltmeter	0-1500 V AC	1
3	Single phase Transformer	1 kVA 230/115 V single phase transformer	1
4	Single phase autotransformer	1 kVA, 0-270V, 10Amp	1

IX Precautions to be followed:

1. Avoid loose connections.
2. Don't touch wire with wet hands.

X Procedure

1. Connect the circuit as shown in the diagram.
2. By using autotransformer apply voltage to the primary winding of the transformer.
3. Observe the readings of primary winding and secondary winding.

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			
3			
4			
5			

XII Actual Procedure followed:

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XIII Observation table

Sr. No.	Primary Voltage (Vp)	Secondary Voltage (Vs)
1		
2		
3		

XIV Result(s)

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XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. Define statically induced emf.
2. Define self induced emf. Give one example of self induced emf
3. Define mutually induced emf. Give one example of mutually induced emf.

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XVIII References/Suggestions for further reading:

1. www.electrical4u.com
2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 3: Measure frequency, Time period, Peak value, RMS value of sinusoidal AC waveform using CRO.

I Practical Significance:

An alternating ac waveform is one that varies in both magnitude and direction in more or less an even manner with respect to time. An AC function can mathematically represent either a power source or a single source with the shape of an AC waveform

II Industry/Employer Expected Outcome(s)

Use electrical equipment efficiently for different electronic engineering application.

Use single phase AC supply for Electrical and electronic equipments

III Course Level Learning Outcome(s)

Analyze A.C. circuits for single phase and polyphase supply.

IV Laboratory Learning Outcome(s)

LLO 1 Use cathode ray oscilloscope.

LLO 2 Identify different parameters on CRO.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

Waveform: The shape of the curve obtained by plotting the instantaneous values of voltage or current as ordinate against time is called its waveform.

Time period (T): The time taken in seconds to complete one cycle of an alternating quantity is called its time period. It is generally represented by *T*. Unit of time period is seconds.

$$\boldsymbol{T = \frac{1}{f}}$$

Frequency (F): The number of cycles that occur in one second is called the frequency (*f*) of the

alternating quantity.

$$\boldsymbol{F = \frac{1}{T}}$$

Amplitude. The maximum value (positive or negative) attained by an alternating quantity is called its amplitude or peak value. The amplitude of an alternating voltage or current is designated by ***Vm*** or ***Im*** respectively.

Average Value: The average value of a alternating quantity is equal to the average of all its instantaneous values over a period of time.

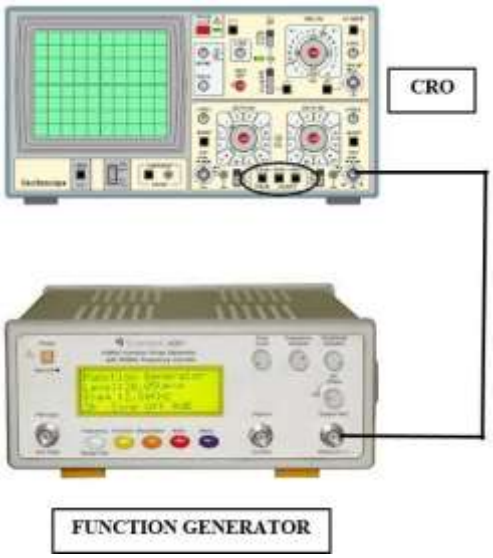
$$Vavg = 0.637 * Vmax$$

Peak Value: It is the maximum value attained by an alternating quantity. The peak or maximum value of an alternating voltage or current is represented by ***Vm*** **or** ***Im.***

R.M.S Value: The effective or R.M.S. value of an alternating current is that steady current (d.c.) which when flowing through a given resistance for a given time produces the same amount of heat as produced by the alternating current when flowing through the same resistance for the same time.

$$Vrms = 0.707 * Vmax$$

VII Actual Circuit diagram used in laboratory with equipment Specifications:



VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	CRO with probe	10 Hz- 30 MHz	1 No.
2	Function Generator	0.1 Hz – 11 MHz	1 No.

IX Precautions to be followed:

Connect the function generator output to the CRO's channel using CRO probe properly.

X Procedure

1. Connect the function generator output to the CRO's channel using CRO probe.
2. Adjust the volt per division and time per division of CRO such that the waveform of the current or voltage can be observed properly.
3. Adjust the peak to peak value of voltage
4. Measure and note down the time period and peak value of sine wave
5. Switch of the supply

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			

XII Actual Procedure Followed:

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XIII Observations:

1. **Time** period of AC waveform (T)= .....division
2. **Time per division=…….**
3. Peak value of ac waveform= .....Division
4. Volt per division= …….

Calculations:

1. Time period of ac waveform (T)= ……..division X ……. Time per division = ……. Seconds
2. Peak value of ac waveform= …….. division X ……..... volt per division = …… volts
3. R.M.S. value of ac waveform = Peak value X 0.707= ..... Volts
4. Average value of ac waveform = Peak value X 0.637= ..... Volts

XIV Results:

1. **Time period.....seconds**
2. **Peak value ..... volts**
3. **R.M.S. value.....volts**
4. **Average value..... volts**

XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

Define waveform, instantaneous value, cycle, amplitude, time period, frequency, angular frequency, R.M.S. value, average value, peak value

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XVIII References/Suggestions for further reading:

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2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 4: Observe the phase difference between voltage and current on CRO for resistive, inductive, and capacitive load and comment on the nature of the power factor (Lagging, Leading, and Unity).

I Practical Significance:

Phase difference between voltage and current in a circuit depends on parameters of the circuit. Based on this, circuit has lagging, leading or unity power factor.

II Industry/Employer Expected Outcome(s)

Use electrical equipment efficiently for different electronic engineering application.

III Course Level Learning Outcome(s)

Analyze A.C. circuits for single phase and polyphase supply.

IV Laboratory Learning Outcome(s)

LLO Identify phase angle and phase difference of given quantities.

LLO Identify the nature of power factor for the respective circuit.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

The phase difference or phase shift as it is also called of a sinusoidal waveform is the angle Φ (Greek letter Phi), in degrees or radians that the waveform has shifted from a certain reference point along the horizontal zero axis. In other words phase shift is the lateral difference between two or more waveform along a common axis and sinusoidal waveforms of the same frequency can have a phase difference.

The phase difference Φ of an alternating waveform can vary between 0 to its maximum timer period T of the waveform during one complete cycle and this can be anywhere along the horizontal axis between Φ = 0 to 2π or Φ = 0 to 360° depending upon the angular units used.

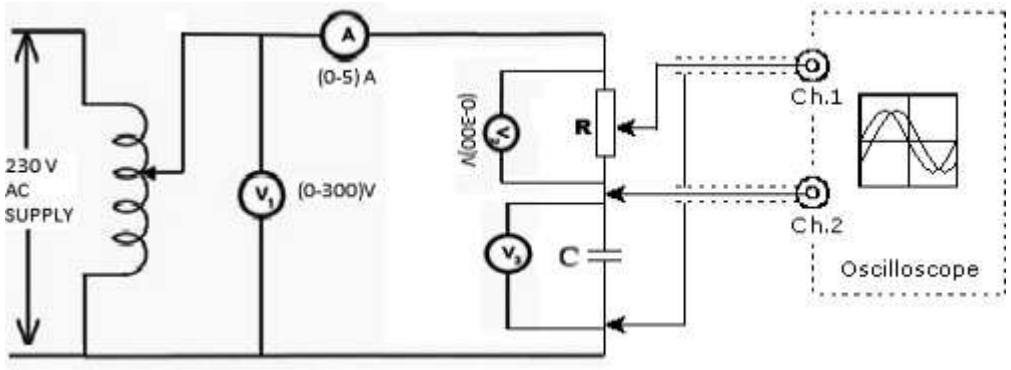
Then the equation for the instantaneous value of a sinusoidal current and voltage waveform

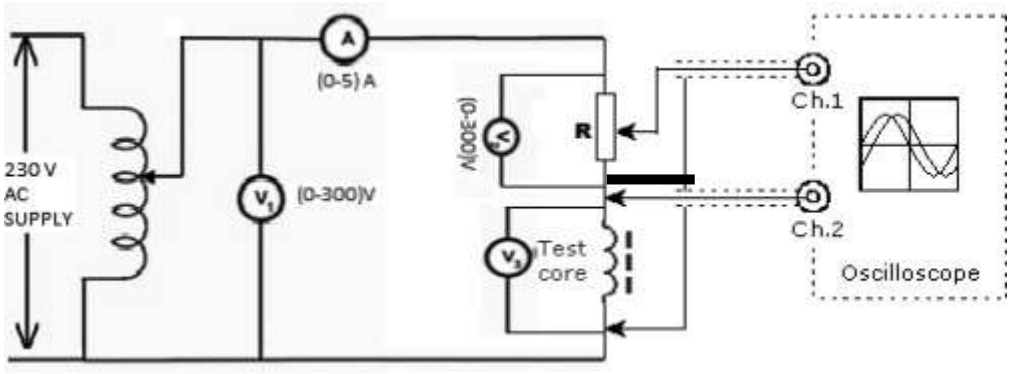
pure resistive circuits are $\boldsymbol{i = Im * sin mt}$ **and** $\boldsymbol{v = Vm * sin mt}$

for pure inductive circuit are $\boldsymbol{v = Vm * sin mt}$ and $\boldsymbol{i = Im * sin(mt - 90)}$

for pure capacitive circuit $\boldsymbol{v = Vm * sin mt}$ and $\boldsymbol{i = Im * sin(mt + 90)}$

VII Actual Circuit diagram used in laboratory with equipment Specifications:





VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Rheostat	Suitable Rheostat	1
2	Inductor	Suitable Inductor	1
3	Capacitor	Suitable Capacitor	1
4	Voltmeter	Suitable Voltmeter	1
5	Ammeter	Suitable Ammeter	1
6	CRO	With 2 attenuator probes	1

IX Precautions to be followed:

1. All electrical connections should be neat and tight.
2. Check the power supply before connection.
3. Connect ammeter in series.
4. Connect voltmeter in parallel.
5. Do not give high voltage to CRO.

X Procedure

1. Connect the circuit as per circuit diagram.
2. Connect the CRO for observing current and voltage waveform.
3. Repeat step 2 for different input voltages.
4. Plot the waveform.

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			
3			
4			
5			
6			

XII Actual Procedure followed:

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XIII Observations and calculations

Sr. No.	Supply voltage (V1)	Voltage across Resistance (V2)	Voltage across Inductor (V3) **OR** Voltage across Capacitor (V3)	Current (I)
1				
2				
3				

XIV Results:

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XV Interpretation of results:

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. Give current, voltage relation in R, L, C element.
2. Draw phasor diagram showing relation between V1, V2 and V3.
3. Obtain phase different between supply voltage and current for setup given.
4. Calculate power factor of the circuit.

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XVIII References/Suggestions for further reading:

1. www.electrical4u.com
2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 5: Connect three phase star connected balanced load and verify the relationship between line voltage and phase voltage, line current and phase current.

I Practical Significance:

In practice, large power application like Transformer, Transmission line etc. use three phase systems. In a three phase circuit loads can be connected in balanced star and delta mode. Practical will help the students to acquire necessary skills.

II Industry/Employer Expected Outcome(s)

Three-phase power is commonly used in factories and manufacturing plants to power large equipment such as compressors, pumps, conveyors, and motors, often use three-phase power to run large fans and pumps It is necessary to formulate voltage and current relations for system parameters for testing , calculations and interpretations.

III Course Level Learning Outcome(s)

Analyze A.C. circuits for single phase and polyphase supply.

IV Laboratory Learning Outcome(s)

LLO 1 Connect star connected three phase load.

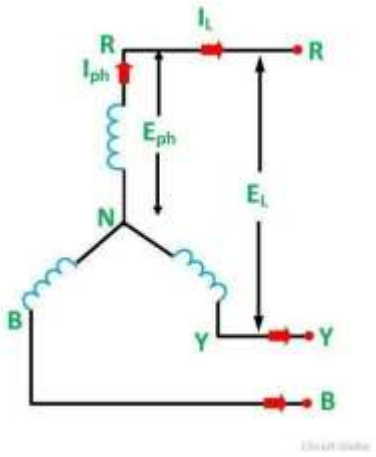
LLO 2 Verify relationship between line and phase quantities.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background (With diagrams if required)

In the **Star Connection**, the similar ends (either start or finish) of the three windings are connected to a common point called star or neutral point. The three-line conductors run from the remaining three free terminals called **line conductors**.



In star connection line voltage is root 3 times of phase voltage.

$$\text{Line voltage} = \sqrt{3} \times \text{Phase voltage}$$

$$E_L = \sqrt{3}\, E_{ph}$$

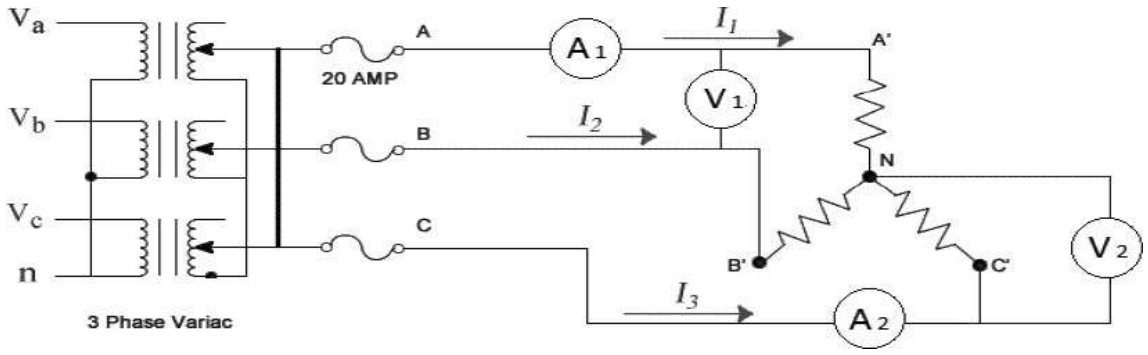
The same current flows through phase winding as well as in the line conductor as it is connected in series with the phase winding.

$$I_R = I_Y = I_B = I_L$$

Star connection is preferred for long distance power transmission because it is having the neutral point. In this we need to come to the concept of balanced and unbalanced current in power system. When equal current will flow through all the three phases, then it is called as balanced current.

Usually, Star Connection is used in both transmission and distribution networks (with either single phase supply or three – phase. Delta Connection is generally used in distribution networks. Since insulation required is less, Star Connection can be used for long distances.

VII Actual Circuit diagram used in laboratory with equipment Specifications:



VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Three Phase Variac	Suitable Three phase variac	1 No.
2	Three Phase load	Suitable range	1 No.
3	A.C. Ammeter	Suitable A.C. ammeter	2 No.
4	A.C. voltmeter	Suitable A.C. Voltmeter	2 No.

IX Precautions to be followed:

1. Avoid loose connections.
2. Don't touch wire with wet hands.
3. Ensure the output voltage of the Autotransformer should be zero.

X Procedure

1. Connect the circuit as shown in circuit diagram.
2. Confirm all the meters should be at zero position.
3. Set the rheostat at maximum position.
4. Set the autotransformer output voltage zero.
5. Switch ON the supply.
6. Record the reading of ammeters, voltmeters.
7. Take different readings at different input voltages.

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			
3			
4			

XII Actual Procedure Followed:

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XIII Observation and Calculation table .

Sr. No.	Line Voltage (volts)	Phase Voltage (Volts)	Line current (Amp)	Phase Current (Amp)	Ratio V_L/Vph	Ratio I_L/Iph

XIV Result(s)

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XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. Define balanced load.
2. State the application of star connection.
3. What will be the value of neutral current for three phase star connected balanced load?
4. State the methods to measure power in three phase circuit.

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XVIII References/Suggestions for further reading:

4. www.electrical4u.com
5. www.howstuffworks.com
6. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		**Weightage**
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 6: Connect three phase Delta connected balanced load and verify the relationship between line voltage and phase voltage, line current and phase current.

I Practical Significance:

In practice, large power application like Transformer, Transmission line etc. use three phase systems. In a three phase circuit loads can be connected in balanced star and delta mode. Practical will help the students to acquire necessary skills.

II Industry/Employer Expected Outcome(s)

Three-phase power is commonly used in factories and manufacturing plants to power large equipment such as compressors, pumps, conveyors, and motors, often use three-phase power to run large fans and pumps It is necessary to formulate voltage and current relations for system parameters for testing, calculations and interpretations.

III Course Level Learning Outcome(s)

Analyze A.C. circuits for single phase and polyphase supply.

IV Laboratory Learning Outcome(s)

LLO 1 Connect Delta connected three phase load.

LLO 2 Verify relationship between line and phase quantities.

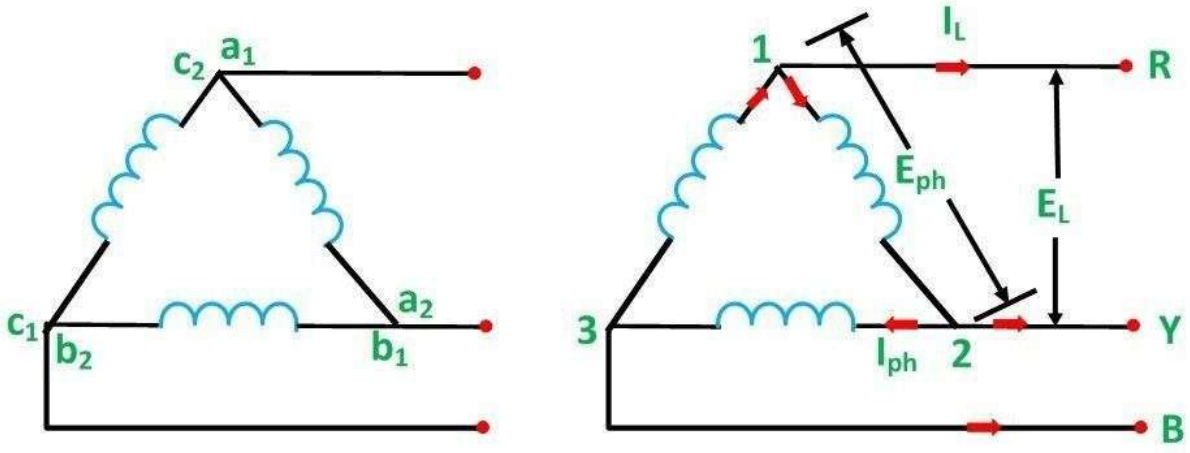
V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background (With diagrams if required)

The delta in a three-phase system is formed by connecting one end of the winding to the starting end of other winding and the connections are continued to form a closed loop. The star in the three-phase system is formed by connecting one end of all three impedances are connected together.

In **Delta (Δ) or Mesh connection**, the finished terminal of one winding is connected to start terminal of the other phase and so on which gives a closed circuit. The three-line conductors are run from the three junctions of the mesh called **Line Conductors**.



To obtain the **delta connections**, a_2 is connected with b_1, b_2 is connected with c_1 and c_2 is connected with a_1 as shown in the above figure. The three conductors R, Y and B are running from the three junctions known as **Line Conductors**.

The current flowing through each phase is called **Phase Current (Iph)**, and the current flowing through each line conductor is called **Line Current (I_L).**

The voltage across each phase is called **Phase Voltage (E_{ph})**, and the voltage across two line conductors is called **Line Voltage (E_L).**

Relation between Phase Voltage and Line Voltage in Delta Connection

$$E_{RY} = E_{YB} = E_{BR} = E_L$$

In delta connection, line voltage is equal to phase voltage.

Relation between Phase Current and Line Current in Delta Connection

In delta connection line current is root three times of phase current.

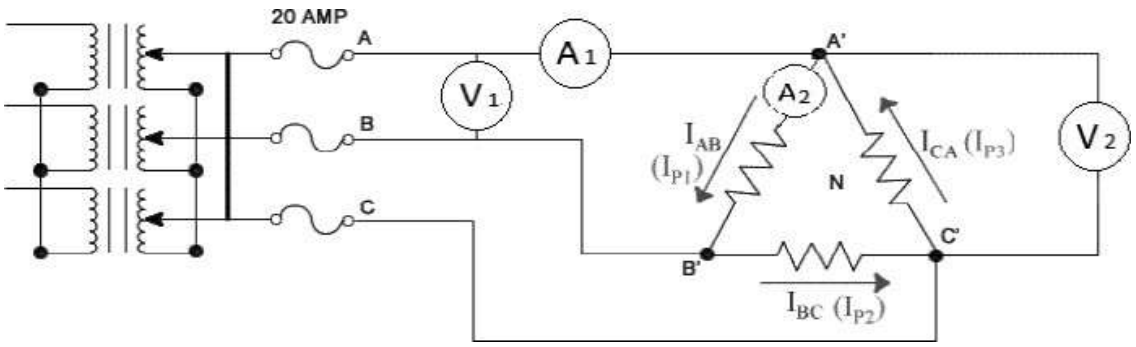
$$\text{Line Current} = \sqrt{3} \text{ x Phase Current}$$

$$I_L = \sqrt{3} I_{ph}$$

In a Delta Connection, the Line and Phase Voltages are same and hence, more insulation is required for individual phases. Usually, Star Connection is used in both transmission and distribution networks (with either single phase supply or three – phase. Delta Connection is generally used in distribution networks

Three Phase balanced network are used in the power industry for the reason of economy and performance. Three phase generators and motors run smoothly, with no torque pulsation, unlike single phase machine. In addition balanced three phase system may be operated as three or four wire systems, which much less copper needed for the power delivered as compared with three single phase systems.

VII Actual Circuit diagram used in laboratory with equipment Specifications:



VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Three Phase Variac	Suitable Three phase variac	1 No.
2	Three Phase load	Suitable range	1 No.
3	A.C. Ammeter	Suitable A.C. ammeter	2 No.
4	A.C. voltmeter	Suitable A.C. Voltmeter	2 No.

IX Precautions to be followed:

1. Avoid loose connections.
2. Don't touch wire with wet hands.
3. Ensure the output voltage of the Autotransformer should be zero.

X Procedure

1. Connect the circuit as shown in circuit diagram.
2. Confirm all the meters should be at zero position.
3. Set the rheostat at maximum position.
5. Set the autotransformer output voltage zero.
6. Switch ON the supply.
7. Record the reading of ammeters, voltmeters .
8. Take different readings at different input voltages.

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			
3			
4			

XII Actual Procedure Followed:

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XIII Observation and Calculation table:

Sr. No.	Line Voltage (volts)	Phase Voltage (volts)	Line current (amp)	Phase Current (amp)	Ratio V_L/V_{ph}	Ratio I_L/I_{ph}

XIV Result(s)

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XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. Define balanced load and unbalanced load.
2. State the application of Delta connection.
3. What are the advantage of three phase system over single phase system?
4. Compare Star and delta connection.

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XVIII References/Suggestions for further reading:

1. www.electrical4u.com
2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 7: Determine the transformation ratio current ratio of single phase transformer.

I Practical Significance:

A single phase Transformer is used for changing voltage levels in electronic circuits. Mostly electronic devices/ circuits are energized with DC supply. To lower the voltage level of AC supply voltage transformer is used and this lowered AC voltage level further rectified to DC supply. Voltage ratio of a transformer decides increasing or decreasing voltage level.

II Industry/Employer Expected Outcome(s)

Use electrical equipment efficiently for different electronic engineering application.

Determine voltage and current ratio of single phase transformer.

III Course Level Learning Outcome(s)

Select the transformer and DC motor for the given application

IV Laboratory Learning Outcome(s)

LLO Calculate transformation ratio of transformer.

LLO Connect transformer to given load.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

Voltage ratio: The voltage ratio of a transformer is equal to the ratio of primary voltage and secondary voltage

$$voltage\ ratio = \frac{Vp}{Vs}$$

Where

Vp = Primary voltage

Vs = secondary voltage

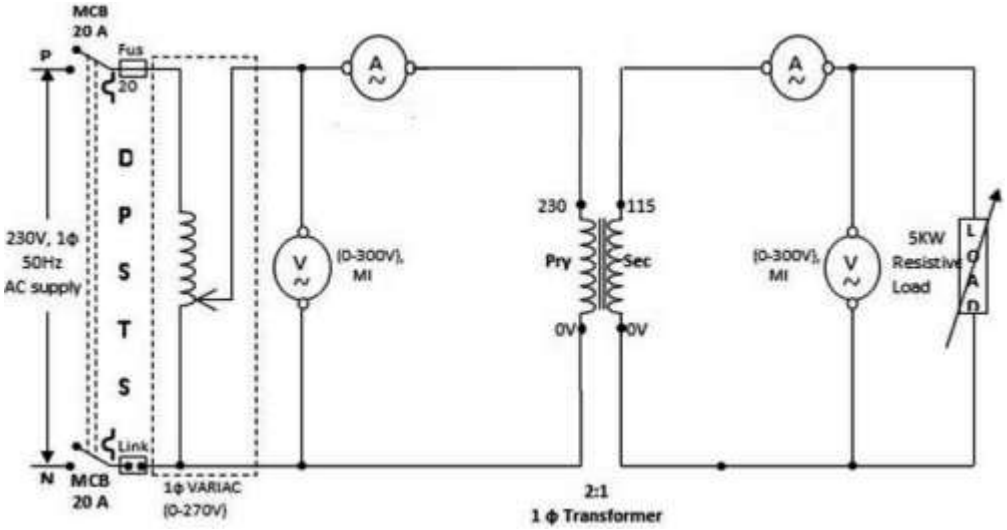
Current ratio: The current ratio of a transformer is equal to the ratio of primary current and secondary current

$$current\ ratio\ = \frac{Ip}{Is}$$

Where

Ip = primary current Is = secondary current

VII Actual Circuit diagram used in laboratory with equipment Specifications:



VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Ammeter	0-10 A AC	2
2	Voltmeter	0-300 V AC	2
3	Single phase Transformer	1 kVA 230/115 V single phase transformer	1
4	Resistive load	Single phase 230V, 15 A Resistive load	1

IX Precautions to be followed:

1. All electrical connections should be neat and tight.
2. Check the power supply before connection.

X Procedure

1. Connect the circuit as per circuit diagram.
2. Switch on power supply.
3. Note down reading of ammeter and voltmeter.
4. Calculate current and voltage ratio

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			
3			
4			

XII Actual procedure followed:

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XIII Observations and calculations

Sr. No.	Primary Voltage (Vp)	Secondary Voltage (Vs)	Primary Current (Ip)	Secondary Current (Is)	Voltage Ratio = (Vp/Vs)	Current Ratio = (Ip/Is)
1						
2						
3						
4						

XIV Results:

Voltage Ratio is …… and current ratio is..... for given transformer

XV Interpretation of results:

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. Define transformer.
2. Define voltage ratio.
3. Define current ratio.
4. Define transformation ratio.
5. State EMF equation of single phase transformer.
6. Define step up and step down transformer.
7. Give applications of step up and step down transformer.

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XVIII References/Suggestions for further reading:

1. www.electrical4u.com
2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 8: Demonstration of working of pulse transformer by observing input pulse and output pulse of pulse transformer on CRO.

I Practical Significance:

Pulse transformers can be divide into two major types, power type and signal type. The power type pulse transformer applications include precise control of heating elements fed from fixed DC source for temperature control. The signal type pulse transformer delivers a pulse like signal or a series of pulses. The turns ratio of the pulse transformer can be used to adjust signal amplitude and provide impedance matching between the source and load. Pulse transformers are often used in the transmittal of signal data and in the gate drive circuitry of transistors, FETs, SCRs etc. Pulse transformer is a very essential and widely used device for low power circuits, high power switched mode power supplies and gate signal generation. Signal type of pulse transformers handle relatively low levels of power. The pulse transformers are usually operated at high frequencies.

II Industry/Employer Expected Outcome(s)

Use Pulse Transformer to test its operation.

III Course Level Learning Outcome(s)

Select the Transformer and DC motor for the given application.

IV Laboratory Learning Outcome(s)

LLO Identify pin configuration of pulse transformer.

LLO Check electrical isolation between input and output of pulse transformer.

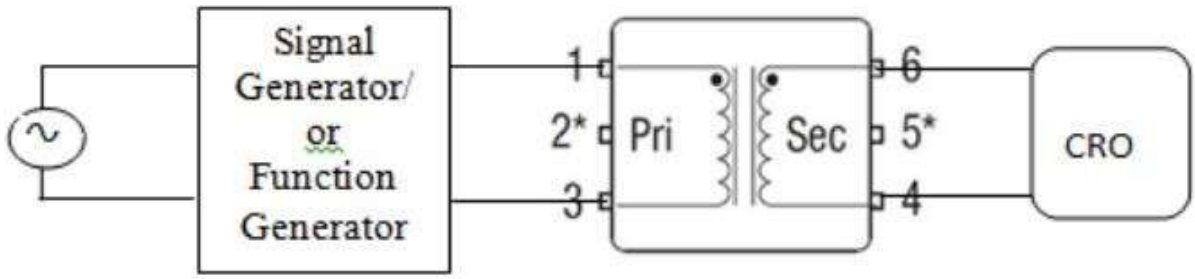
V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

Pulse transformers are a diverse family of transformers designed to transfer a digital control signal from a control circuit to a load. They provide galvanic isolation to a circuit, whilst allowing fast control signals to be transmitted without distorting the signal shape. The input and output signal is typically a rectangular wave of a few volts with a frequency above 100kHz, not a sinusoidal wave as with conventional transformers. Pulse transformers have a low member of windings and low inter winding capacitance. As they operated with high frequency signals, the core material must be able to cope with repeated and rapid magnetization and demagnetization. The turn's ratio is typically 1:1 as their main purpose is not to increase or transform the voltage, but to maintain it across the isolation barrier.

VII Actual Circuit diagram used in laboratory with equipment Specifications:



VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Pulse transformer of suitable rating	Input voltage and frequency of relevant rating. 1 vpp signal at 1kHz	1
2	CRO	10 Hz- 30 MHz	1
3	Function generator	0.1 Hz – 11 MHz	1

IX Precautions to be followed:

1. Follow safety practices.
2. Do not make any connections with the power supply is ON.

X Procedure

1. Make the connections as per circuit diagram.
2. Energies primary pins 1 & 3 at relevant suitable voltage and frequency say 1kHz, 100mV.
3. Observe the waveform at the secondary pin 4 & 6.
4. Measure the input and output voltage and check for turns ratio

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			
3			

XII Actual Procedure followed:

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XIII Observations:

Sr. No.	Input voltage(volt)	Output voltage (volt)	Nature of input waveform	Nature of output waveform
1				
2				
3				
4				

XIV Results:

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XV Interpretation of results:

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XVI Conclusion and recommendation:

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XVII Practical related questions (Provide space for answers)

1. Why the pulse transformer has less number of turns and low inter winding capacitance.
2. Compare between conventional transformer and pulse transformer.
3. List applications of pulse transformer.

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XVIII References/Suggestions for further reading:

1. www.electrical4u.com
2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 9: Identify different types of DC motor by observing terminal connections and also identify different parts of DC motor.

I Practical Significance:

In industry it is require to dismantle machines for overhauling purpose and reassemble. Also it is necessary to identify different types of DC motor by observing terminal connections. Through this practical student identifies motor by observing terminal connections also student identifies different parts and their functions.

II Industry/Employer Expected Outcome(s)

Use electrical equipment efficiently for different electronic engineering application.

Identify parts and types of DC motor and select DC motor for particular applications.

III Course Level Learning Outcome(s)

Select the transformer and DC motor for the given application

IV Laboratory Learning Outcome(s)

LLO Identify different parts DC motor.

LLO Identify different types of DC motor.

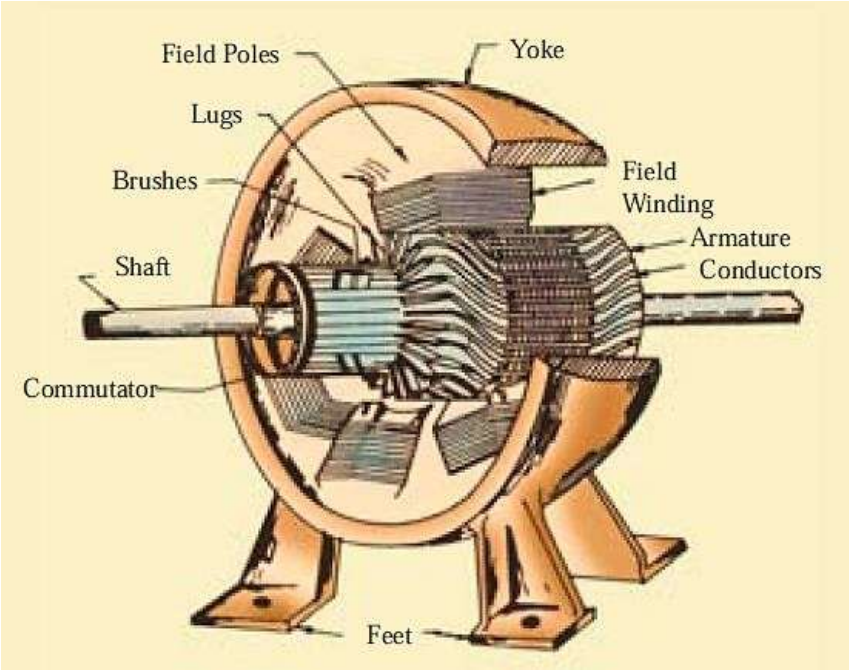
V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

- When DC machine converts electrical energy into mechanical energy machine operates as DC motor.
- Principle of operation: When current carrying conductor is placed in a magnetic field, it experienced a force.
- Constructional features of dc machine.
- Functions of different parts of DC machine.

VII Actual Circuit diagram used in laboratory with equipment Specifications:



VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	DC motor	3 HP 220V, DC	1

IX Precautions to be followed:

1. Make sure that the main switch on the panel board is in 'OFF' position and DC machine is disconnected from the supply.
2. The motor is mechanically disconnected form the load.

X Procedure

1. Remove the mechanical load of motor.
2. Observe the external parts such as frame, eye bolt and foundation plate etc.
3. Remove end covers.
4. Observe the various internal parts and their shapes, positions and material used.
5. Note the material used for each part.
6. Write down in brief function of each part.
7. Reassemble the motor by putting back the end cover in original place.

XI Required Resources/apparatus/equipment with specification:

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			

XII Actual Procedure Followed:

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XIII Observations:

Sr. No.	Name of the part	Material used	Function of the part
1	Yoke		
2	Eyebolt		
3	Frame		
4	Armature		
5	Armature winding		
6	Pole		
7	Pole shoe		
8	Field winding		
9	Commutator		
10	Brushes		
11	Brush holder		
12	Bearing		
13	Shaft		

Observe the terminal connections of given DC motor and state the type of the DC motor

Type of DC motor = …….

XIV Results:

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XV Interpretation of results:

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XVI Conclusion and recommendation:

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XVII Practical related questions (Provide space for answers)

1. State working principle of DC motor.
2. State Fleming's left hand rule.
3. State types of DC motors.
4. Write applications of different types of DC motors.

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XVIII References/Suggestions for further reading:

1. www.electrical4u.com
2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 10: Start any DC motor using corresponding starter and observe speed on tachometer.

I Practical Significance:

DC shunt motor draws very high current during starting which may burn armature winding. Hence to protect DC shunt motor from damage due to heavy starting current, Three point starter is used to start DC shunt motor.

II Industry/Employer Expected Outcome(s)

Use electrical equipment efficiently for different electronic engineering application.

Select and connect DC motor to DC supply using particular starter for different applications.

III Course Level Learning Outcome(s)

Select the transformer and DC motor for the given application.

IV Laboratory Learning Outcome(s)

LLO Connect DC motor to DC supply.

LLO Select particular starter for particular motor starting.

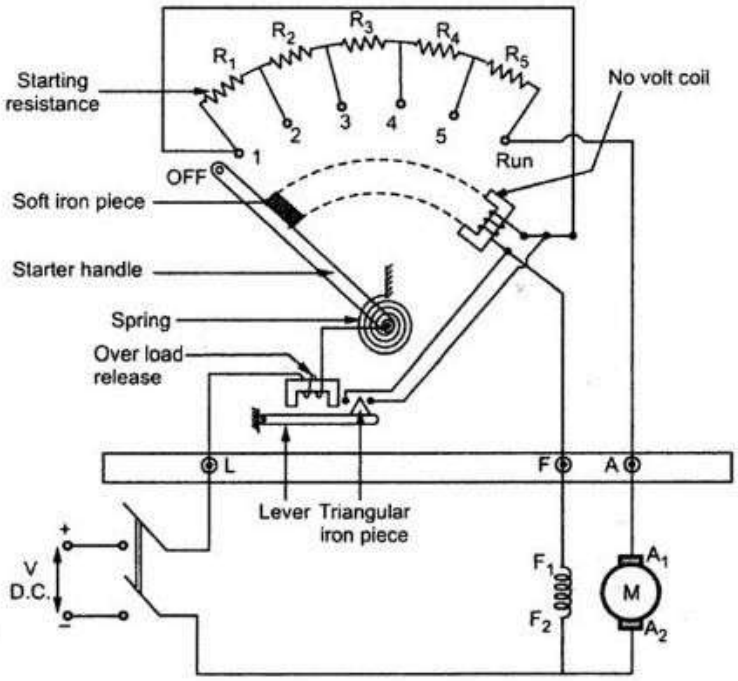
V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

- 3 point starter is a device whose main function is starting of DC shunt motor. The 3 point starter connects the resistance in series with the circuit which reduces the high starting current and hence protect DC Shunt motor from damage. For DC series motor 2 point starter is used.

VII Actual Circuit diagram used in laboratory with equipment Specifications:



VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	DC motor	3 HP 220V, DC	1
2	DC supply	220V DC 20 Amp	1
3	Three point starter	Suitable for 3 HP DC shunt motor	1
4	Tachometer	Suitable range around 0 to 5000 rpm	1

IX Precautions to be followed:

1. Connect the three point starter with DC shunt motor properly.

X Procedure

1. Connect the circuit as shown in circuit diagram.
2. Switch on DC supply.
3. Move the handle of 3 point starter from Start to Run position gradually.
4. Observe the starting of DC shunt motor.
5. By using tachometer measure the speed of the DC shunt motor

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			
2			
3			

XII Actual Procedure followed:

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XIII Observations:

Sr. No.	Speed of DC shunt motor in RPM
1	
2	

XIV Results:

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XV Interpretation of results:

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. State types of starters used for DC motors.
2. Starter is necessary for starting of DC motors.
3. Write the functions of different parts of three point starter.

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XVIII References/Suggestions for further reading:

1. www.electrical4u.com
2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 11: Start single phase induction motor and reverse the direction of rotation of it.

I Practical Significance:

Single phase induction motor is necessary in some industrial process applications. Stator of Single phase Induction motor consist of Main winding & starting winding placed at 90° electrically apart to produce rotating magnetic field. For this capacitor is connected in series with starting winding along with centrifugal switch.

II Industry/Employer Expected Outcome(s)

Use FHP motors for diversified applications. Reverse the direction of rotation of single phase induction motor.

III Course Level Learning Outcome(s)

Select the fractional horse power motor for the given application.

IV Laboratory Learning Outcome(s)

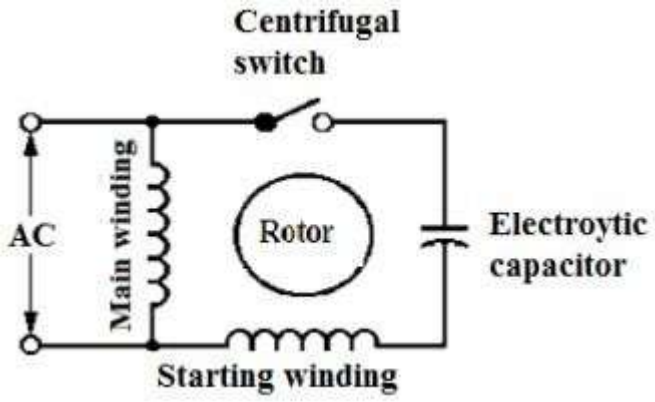
LLO Connect single phase induction motor to the supply.

LLO Change the direction of rotation of single phase induction.

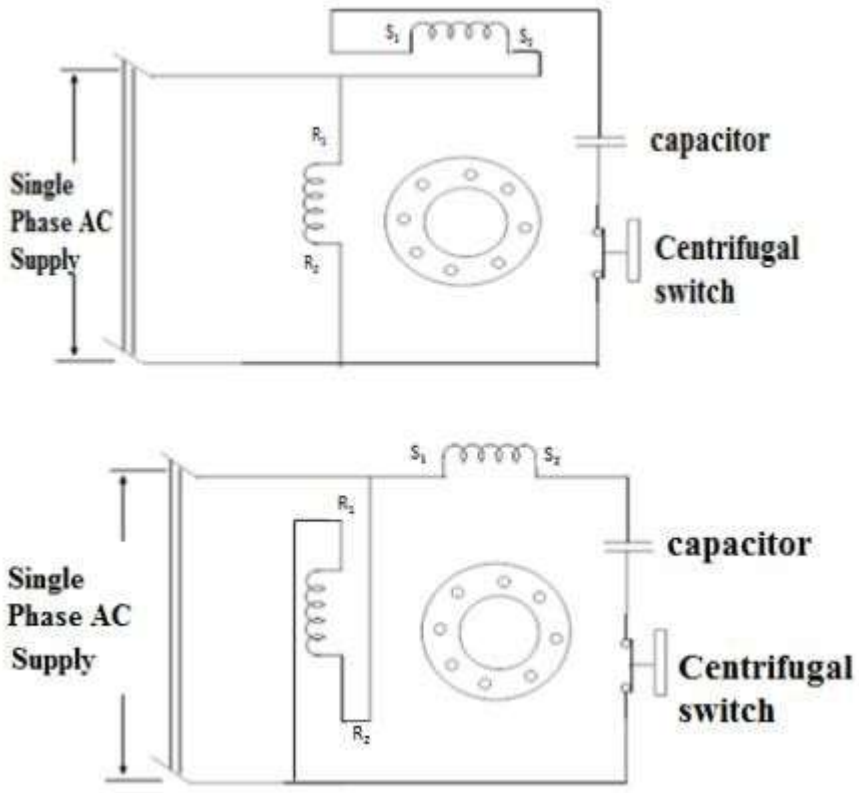
V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background



- In single phase induction motor main winding is designed for low resistance & starting winding for high resistance. Phase difference in both winding is produced by connecting capacitor in series with starting winding. Direction of rotation of single phase induction motor depends upon the instantaneous polarities of main winding flux & starting winding flux. So direction of rotation can be changed by reversing the polarity of either main or starting winding as shown in figure.



VII Actual Circuit diagram used in laboratory with equipment Specifications:

Diagram for forward direction of rotation

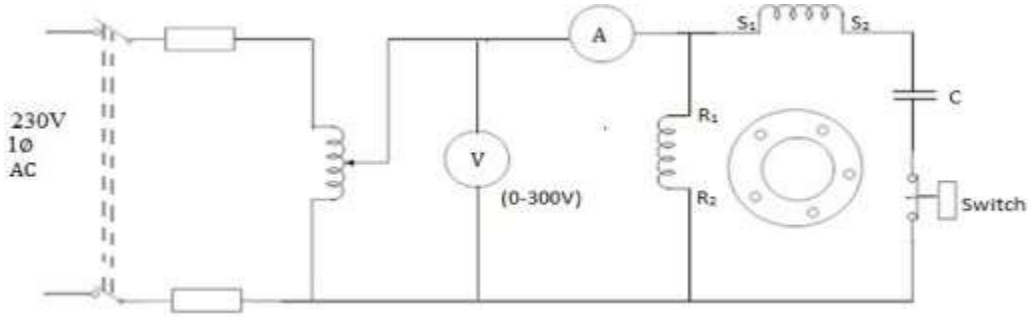


Diagram for reversing direction of rotation:

(Students can draw the circuit diagram; write meter ranges & specifications of equipments)

VIII Required Resources/apparatus/equipment with specification:

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Single phase induction motor	1/2 HP single phase 230V	1
2	Ammeter	0-5 A, AC	1
3	Voltmeter	0-300 V AC	1
4	Autotransformer	Single phase 0-270V, 10A	1

IX Precautions to be followed:

1. Make sure that main switch is in OFF position while making connection
2. All electrical connections should be neat and tight.

X Procedure

1. Connect circuit as per circuit diagram
2. Switch ON the supply
3. Start the motor and check the direction of rotation
4. Change starting winding terminals and check the direction of rotation.

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			
3			
4			

XII Actual Procedure Followed:

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XIII Observations:

Condition	Direction of rotation
Initial connection	Forward / Reverse
Reversing starting winding connections	Forward / Reverse

XIV Results:

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XV Interpretation of results:

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. State different types of single phase induction motors.
2. Differentiate between main winding & starting winding.
3. State the type of capacitors used in 1 phase induction motor.
4. Give the applications of various types of 1 phase induction motor.
5. State the function of centrifugal switch.
6. '1 phase induction motor is not self-starting.'- Justify
7. 'Main winding resistance is low & starting winding resistance is high. 'Give reason

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XVIII References/Suggestions for further reading:

1. www.electrical4u.com
2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 12: Start universal motor and reverse the direction of rotation of it.

I Practical Significance:

Reversal of rotation of Universal motor plays an important role in electrical and electronic engineering for different medical instrumentation applications.

II Industry/Employer Expected Outcome(s)

Use universal motor for different applications. Reverser the direction of rotation of universal motor.

III Course Level Learning Outcome(s)

Select the fractional horse power motor for the given application.

IV Laboratory Learning Outcome(s)

LLO Connect the universal motor to the supply.

LLO Change the direction of rotation of universal motor.

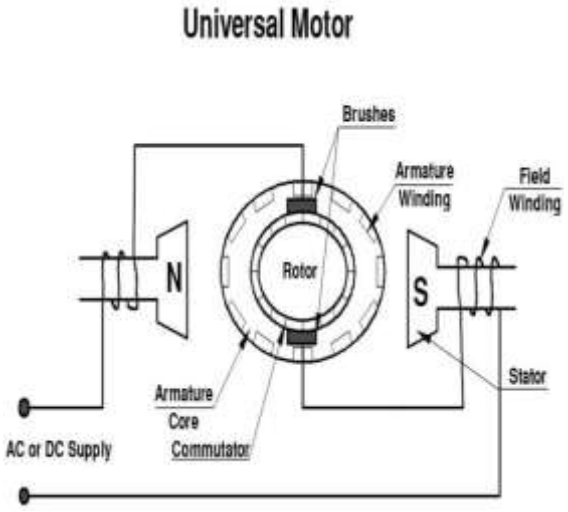
V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

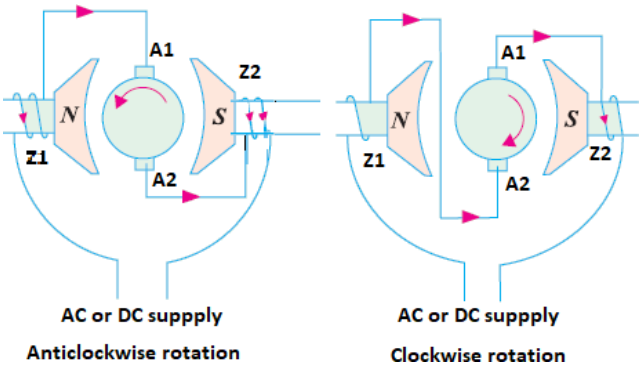
VI Relevant Theoretical Background

Universal motor can be operated on AC and DC supply. It consists of armature, armature winding, field winding, armature winding and field winding are connected in series with each other since this is basically a series motor.

The direction of rotation of a universal motor can be changed by either: (i) Reversing the field connection with respect to those of armature; or (ii) By using two field windings wound on the core in opposite directions so that the one connected in series with armature gives clockwise rotation, while the other in series with the armature gives counterclockwise rotation.



VII Actual Circuit diagram used in laboratory with equipment Specifications:



VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Universal motor	Suitable rating	1
2	Supply AC or DC	Suitable supply	1

IX Precautions to be followed:

1. All electrical connections should be neat and tight.
2. Check the power supply before connection.

X Procedure

1. Connect universal motor to AC/DC supply.
2. Mark the rotation of motor.
3. Change the armature winding terminal.
4. Mark the rotation of motor.

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			

XII Actual Procedure Followed:

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XIII Observations:

Sr. No.	Winding connection	Direction of rotation
1	Normal	
2	Reversed	

XIV Results:

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XV Interpretation of results:

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. State working of universal motor.
2. State main parts of State different types of single phase induction motors.
3. Give applications of universal motor.

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XVIII References/Suggestions for further reading:

1. www.electrical4u.com
2. www.howstuffworks.com
3. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 13: Identify different parts of linear induction motor and start it.

I Practical Significance:

Identification and use of different parts of Linear Induction Motor by observing terminal connections plays important role in engineering. Also Identification of different parts of Linear Induction motor with their functions and material used.

II Industry/Employer Expected Outcome(s)

In Industry Linear Induction motor is used to drive conveyors, sliding doors, machine tools etc. To develop the skills for the industry in application of linear induction motor and identify different parts of linear induction motor.

III Course Level Learning Outcome(s)

Select the fractional horse power motor for the given application.

IV Laboratory Learning Outcome(s)

LLO Connect the linear induction motor to the supply.

LLO Observe linear motion of induction motor.

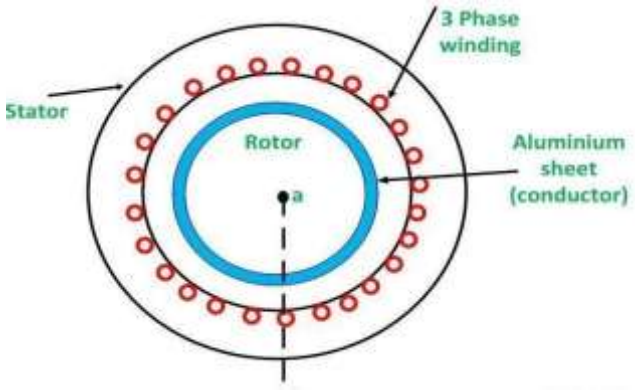
V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

What is Linear Induction Motor

A Linear Induction Motor (or **LIM**) is a special type of induction motor used to achieve rectilinear motion rather than rotational motion as in the case of conventional motors. Linear induction motors are quite an engineering marvel, to convert a general motor for a special purpose with more or less similar working principle, thus enhancing its versatility of operation. Let us first look into the construction of a linear induction motor.



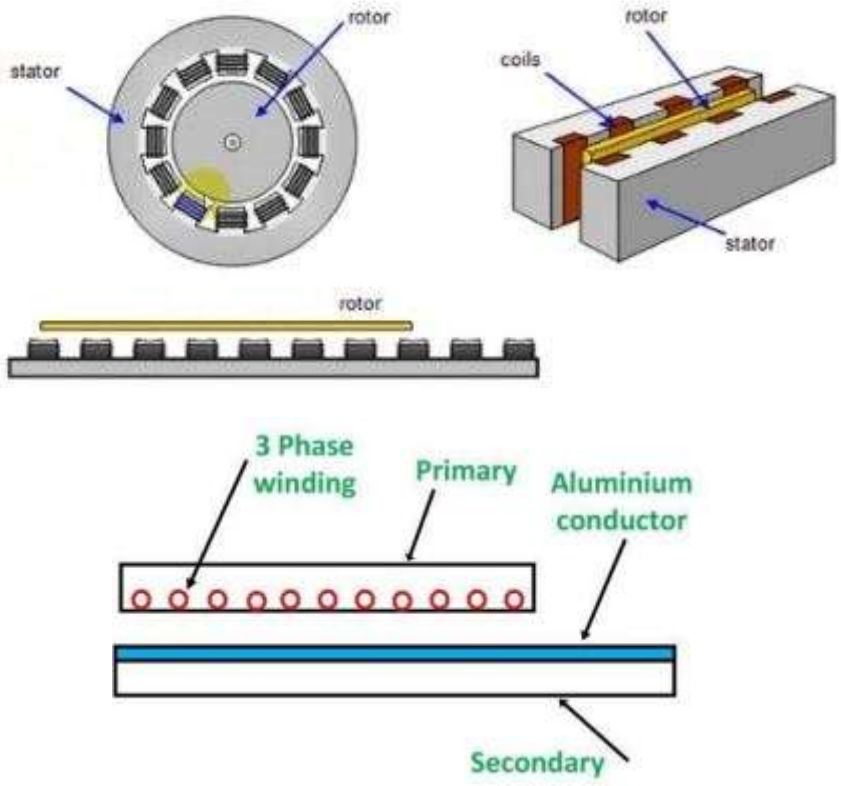
The basic design and construction of a linear induction motor is similar to a three phase induction motor, although it does not look like a conventional induction motor. If we cut the stator of a polyphase induction motor and lay on a flat surface, it forms the primary of the linear induction motor system. Similarly, after cutting the rotor of the induction motor and making it flat, we get the secondary of the system.

Application of Linear Induction Motor

A **linear induction motor** is not that widespread compared to a conventional motor, taking its economic aspects and versatility of usage into consideration. But there are quite a few instances where the LIM is indeed necessary for some specialized operations.
Few of such applications are listed below.

1. Automatic sliding doors in electric trains.
2. Mechanical handling equipment, such as propulsion of a train of tubs along a certain route.
3. Metallic conveyor belts.
4. Pumping of liquid metal, material handling in cranes, etc.

VII Actual Circuit diagram used in laboratory with equipment Specifications:



VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Linear induction Motor	Suitable range	1 No.

IX Precautions to be followed:

1. Follow safety Practices.
2. Avoid loose connections.
3. DO NOT make any connections with the power supply ON.

X Procedure

1. Observe the different parts of Linear Induction Motor.
2. View the external and internal parts of motor.
3. Note the material of each part of motor.
4. Write down in brief the function of each part after observation.
5. Start the linear induction motor smoothly.

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			

XII Actual procedure Followed:

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XIII Observation (Use blank sheet, If space is not sufficient)

Sr. No.	Name of the Part	Material Used	Function
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XIV Result(s)

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XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. List the different types of Fractional horse power motors.
2. State the application Linear Induction Motor.
3. Write specification of any one linear Induction motor.
4. State Working principle of Linear Induction motor.

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XVIII References/Suggestions for further reading:

7. www.electrical4u.com
8. www.howstuffworks.com
9. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 14: Identify different types of fuses and circuit breakers. State their specification for suitable application.

I Practical Significance:

Identification of switchgears plays an important role in electrical and electronic engineering because without these components such as relays, solenoids, inductors, chokes, coils, loudspeakers, motors, generators, transformers and electricity meters etc. would not work.

II Industry/Employer Expected Outcome(s)

Identify and use relevant protective devices / switchgear for different requirements.

III Course Level Learning Outcome(s)

Choose the protective devices for the electrical protection.

IV Laboratory Learning Outcome(s)

LLO Select fuse for particular application.

LLO Select circuit breaker for particular application..

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

Switches, fuses, switch fuse and fuse switch units, MCB, MCCB and ELCB are the switchgears used for safety of electrical equipment.








VII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Different switchgears	Suitable rating	1

VIII Precautions to be followed:

1. Select proper switchgear.

IX Procedure

1. Observe the various switchgears.
2. Write the function and application of each switchgear.

X Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			

XI Actual Procedure followed:

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XII Observations:

Sr. No.	Switchgear name	Function
1	Fuse	
2	MCB	
3	ELCB	
4	HRC fuse	
5	Relay	
6	Circuit breaker	
7	MCCB	
8	Switch	

XIII Results:

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XIV Interpretation of results:

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XV Conclusion and recommendation

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XVI Practical related questions (Provide space for answers)

1. State use of MCB and ELCB. Also write specification of the same.
2. State various types of switchgears used in engineering.

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XVII References/Suggestions for further reading:

3. www.electrical4u.com
4. www.howstuffworks.com
5. www.electricaltechnology.org

XVIII Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 15: Testing of Earthing using a test lamp and comment on it.

I Practical Significance:

Testing of electrical circuit plays an important role in electrical and electronics equipment's. Testing of components such as relays, solenoids, inductors, chokes, coils, loudspeakers, motors, generators, transformers and electricity meters etc., it is necessary for fault finding, satisfactory performance of equipment's, safety of operator, life of equipment etc.

II Industry/Employer Expected Outcome(s)

It is used to measure whether items that should be connected to the earthing system are effectively bonded, and can quickly identify such problems as corroded connections, loose bolts, inadvertent connections or separations. In industry student improve skill to use electrical equipment in industry application.

III Course Level Learning Outcome(s)

Choose the protective devices for the electrical protection.

IV Laboratory Learning Outcome(s)

LLO Explain connection of earthing for domestics application.

LLO Test available of earthing for given switch board.

V Relevant Affective Domain related outcome(s)

Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background (With diagrams if required)

Earthing is defined as **"**the process in which the instantaneous discharge of the electrical energy takes place by transferring charges directly to the earth through low resistance wire."

Low resistance earthing wire is chosen to provide the least resistance path for leakage of fault current. To ensure safety, earthing can be done by connecting the electrical appliance to earthing systems or electrodes placed near the soil or below the ground level.

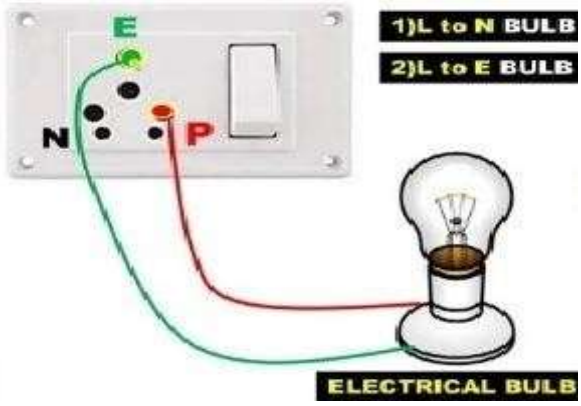
We all must know How to Check Earthing at Home with Test Lamp and Multimeter in order to be safe. Proper earthing at home ensures safety in case of electrical shock. Checking value / voltage of earthing in home electrical socket is very easy. We can check if earthing is proper or not using a Test Lamp or a Multimeter.

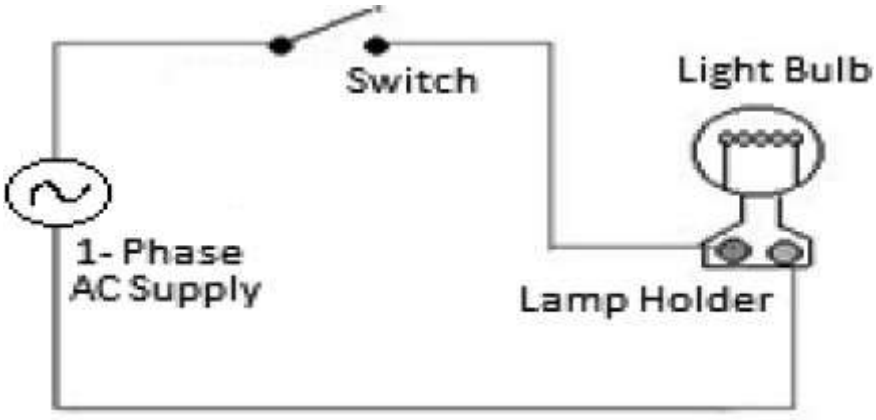
A Multimeter is an indispensable tool that is used to diagnose and troubleshoot circuits. As its name indicates, it is a meter capable of measuring multiple things related to electricity namely voltage , current and resistance. Multimeter and Test lamp can be used to find open circuit and short circuit in electric circuit.

What is a Test Lamp?

A Test Lamp is a Florescent Bulb connected to a Holder and Electrical Wire. Most electricians use Test Lamps as a voltage tester to check Earthing and other electrical connections.

VII Actual Circuit diagram used in laboratory with equipment Specifications:





VIII Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	3 pin socket with switch	Single phase , 230 v, 50 Hz , AC Supply	1 No.
2	Lamp with holder	Suitable range	1 No.

IX Precautions to be followed:

1. Avoid loose connections.
2. Don't touch wire with wet hands.

X Procedure

1. Insert the Positive Wire of the Test Lamp in the Positive side (Right Hole) of the Socket and Negative Wire to the Negative side of the Socket (Left Hole).
2. Switch ON. The Bulb will Glow at Full Brightness.
3. Remove the Negative Wire (Leave the Positive Wire as it is).
4. Insert the Negative wire in the Earthing of the Socket (Top single Hole).
5. The Bulb must Glow with Full Brightness as before.
6. If the Bulb does NOT Glow at all then there is NO Earthing / Grounding. If the Bulb Glows Dim, then it means the Earthing is Not Proper.

XI Required Resources/apparatus/equipment with specification:

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1			
2			

XII Actual Procedure followed:

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XIII Observation table:

Sr. No.	Lamp connection	Lamp Brightness (Bright / Dim / No)	Remark
1	Between Phase and Neutral terminal		
2	Between Phase and Earth terminal		
3	Between Earth and Neutral terminal		

XIV Result(s)

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XV Interpretation of results

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XVI Conclusion and recommendation

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XVII Practical related questions (Provide space for answers)

1. Define Earthing. List the types of earthing.
2. State the need of Earthing.
3. Give the application of earthing.
4. List the advantages of Earthing.

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XVIII References/Suggestions for further reading:

10. www.electrical4u.com
11. www.howstuffworks.com
12. www.electricaltechnology.org

XIX Suggested Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		**60 %**
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		**40%**
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusions	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		**100 %**

Marks Obtained			**Dated signature of teacher**
Process Related (15)	**Product Related (10)**	**Total (25)**	